JPEG History

- **Started as a European consortium**
- **CCITT and ISO working Groups Combined to forum1985**
- **ISO IS 10918-1 Requirements and Guidelines July 1992**
  - **Lossy**
    - » **8 and 12 bit DCT**
    - » **Sequential, Progressive, Hierarchical**
    - » **Huffman, Arithmetic encoding**
  - **Lossless**
    - » **4-16 bit DPCM**
    - » **Huffman, Arithmetic encoding**
  - **Also accepted by CCITT as Recommendation ISO IS 10918-2 Compliance Testing 1994**
  - **Compliance test methodology and data for most modes of JPEG**
- **ISO IS 10918-3 Extensions October 1995**
  - **Lossy extensions**
    - » **Tilling, Variable Quantization (Rate Control), Selective Refinement**

ISO/CCITT JPEG

- **Developed as a "Tool Box" of compression techniques so that applications can select one of several modes of the JPEG dependent on their Baseline JPEG is 8-bit sequential DCT with Huffman encoding**

- **Optimization of JPEG quantization tables and Huffman tables improves quality**

  - **Optimize on individual images or class of images**

  - **Optimize on a given bit rate**

  - **Gain of 10-20% with optimization**

  - **Left to commercial vendors/users for competitiveness JPEG is used in most commercial imaging shop, ERDAS)**

  - **Image Collection (Digital Cameras- Kodak, Fuji, Cannon)**

  - **Image Communications**

JPEG Activities

- **New work items**
  - **Improved lossless/near lossless compression**
  - **lossy bi-level compression**
  - **Improved lossy compression (JPEG 2000)**
  - **Multidimensional(Multispectral) JPEG**
  - **Section 4: "Registration of JPEG Profiles, APPn Markers, SPIFF profiles, SPIFF colour space, SPIFF tags."**
- **Active Participants (member has grown from 15 to 110)**
  - **US (Kodak, Polaroid, IBM, ATT, HP, Delta Information, RICOH, Optivision, DoD) (membership has grown from 15 to 80)**
  - **France (AFNOR, AVELLEM)**
  - **JAPAN (NTT, Mitsubishi, Canon)**
  - **UK (Elysion)**
- **3 Meetings a Year at ISO level**
  - **1 each in Europe, Asia, US (common)**
- **3 Meetings a year at ANSI level**
  - **Alternate west cost - east cost**

Improved Lossless/Near Lossless Compression

- **Convergence has been accomplished for baseline**
  - Current vote on DIS to IS
  - More work will be completed for Extensions
- **Gain of 5 - 100% in compression**
  - Image dependent
  - 100% is based on compound documents (text and image)
- **Baseline algorithm**
  - DPCM based
  - Baseline algorithm
    - » MED predictor (HP) is baseline predictor
    - » Golomb-Rice entropy encoder
    - » For the run state, MELC1 will be used
  - Possible Extensions
    - » CALIC algorithm (High complexity, higher compression)
    - » Arithmetic encoders

Improved Lossy Compression

- **Document ISO/IEC JTC1/SC29/WG1 N292 R2**
  - **Over 50 people/organizations have received the submission package**
  - **New standard expected 1999- 2000**
    - » **Proposals due Sept. 30 97**
    - » **Evaluations Nov. 97**
    - » **Working Draft (WD) to Committee Draft (CD) Nov. 98**
    - » **CD to Draft International Standard (DIS) Aug. 99**
    - » **DIS to International Standard (IS) 2000**

- **Goals:**
  - **Superior low bit-rate performance**
  - **Unified continuous-tone and bi-level compression**
  - **Unified lossless and lossy compression**
  - **Robustness to bit-errors**
  - **Progressive transmission by pixel accuracy and resolution**
  - **Post-compression quantization and parsing options**
  - **Fixed-rate, fixed-size, limited workspace memory**
  - **Maximum Flexibility, and other goals**

Evaluation Overview

- **For the evaluation we;**
  - **Received 24 Full submissions (11 late)**
    - » **Thank the people who submitted**
    - » **Grateful for the people who did not submit**
  - **Fixed all the incorrect submissions**
  - **Processed over 5,000 images**
  - **Printed over 1,000 images**
  - **Tabulated results for each image category**

Numerical Performance

- **Rated RMS error, Max error, SNR, 10-90 percent error**
  - Average for image category and bit rate
    - » RMS error
    - » Max error
  - Rank ordered for image category and bit rate
  - Graphed for each bit rate and each category
    - » RMS error
    - » Max error
    - » IF the algorithm did not do all images in that category for that bit rate they did not get a score

Subjective Performance

- **We are running a subjective image quality evaluation over the next 3 days**
  - **Need 6 evaluators in the morning and 6 in the afternoon**
    - » **Please sign up with Bernie Brower or Alan Chien**
    - » **Evaluations are from 8 - 12, 1 - 5 each day in the Terrace Room 10th floor, 3 - 4 hours each**
    - » **Evaluate 9 packets (1 image, 1 bit rate, up to 24 algorithms per packet)**
  - **Will present preliminary results at the end of the meeting**

Submission Overview

- **24 Submissions**
    - **12 Do lossless**
    - **24 Do lossy**
    - **12 Do large images**
    - **24 Do single byte images**
    - **17 Do two byte images**
    - **11 Do Bi-level images**
    - **7 Do colour**

Transform	Quantization	Coder
18 Wavelets 4 DCT 5 Other	10 Scalar 7 Bit Plan 6 Other	5 Q-Coder 9 Other arithmetic 2 Bit Plane 5 Huffman 2 Other

Core Experiments

- **Core experiments are used to improve the baseline algorithm**
  - Reduce complexity with no loss in image quality/compression ratio
  - Increase compression ratio/quality with no increase in complexity
- **27 Core experiments are defined**
  - Transform experiments
    - » Improved wavelets
    - » Colour transforms
    - » DCT experiments
  - Quantization
    - » Simple quantization
    - » HVS quantization
  - Encoding
    - » Nine different encoding techniques
  - Other
    - » Bit error resistance
    - » Features (Progressive transmission, lossless, . . .)

Multidimensional JPEG

- **Document ISO/IEC JTC 1/SC 29/WG 1 N283 Revised: "Call for Statements of Interest and Refinement of Requirements for Lossy Compression of Multiple-Component Still Pictures"**

- **Working draft is completed**
  - Convergence has been completed
  - Still some open issues that need to be tested
    » More advanced Blocking techniques
    » Selection of spatial compression technique
    » Scaling techniques

- **Main goal is to compress multispectral imagery with JPEG like algorithm.**
  - Convergence will be a preprocessor (spectral decorrelation) on the data and then use JPEG DCT or JPEG 2000

Section 4: Registration of Profiles and Markers

- **Fast track of writing ISO 10918-Part 4: "Registration of JPEG profiles, SPIFF profiles, SPIFF tags, SPIFF colour spaces, and APPn markers"**
  - **Current voting on DIS to IS**
- **NITFS concerns about the WD of Part 4**
  - **Registration of APPn marker codes**
    - » **All APPn markers must include a null terminate identification string**
    - » **This is included in the APP7 marker used by NITFS**
    - » **It is not included in the APP6 marker currently used**
    - » **Also, not include in the proposed APP8 and APP9 marker codes**
    - » **APP8 is reserved for SPIFF use only**
  - **Interim Registration Authority**
    - » **AFNOR (France)**

Next Meetings

- **NCITS/L3.2 JPEG (ANSI Level)**
  - **1998, 27 April - 1 May   Snowbird,UT**
  - **1998, 14 - 18 September   St. Petersburg, FL**
  - **1999, January   West coast**

- **ISO/IEC JTC 1/SC 29/WG 1 JPEG meetings**
  - **1998, 23 - 27 March   Geneva, Switzerland**
  - **1998, 6 - 10, July   Denmark**
  - **1998, 2 - 6, November   USA**
  - **1999, March   Korea**

Kodak Software Project

- **Applications (for info Jim Doran jd@kodak.com (716) 253-5734)**
  - Kodak's Operational Imaging Program (OIP)
    - » Multimedia catalog and search (database) application
  - Kodak's Operational Imaging Display Tool (OIDT)
    - » Simple display tool to go with database for viewing full size images
- **Procedure**
  - Modify current OIP and OIDT to read NITFS 2.0 (and 1.1 imagery)
  - Current software runs on windows NT 4.0 (and Windows 95)
  - Use NIMS tools to incorporate these capabilities
- **Tools needed**
  - Platform : Windows NT 4.0 (and Windows 95)
  - Compiler: Microsoft Visual C++ 5.0
  - Library: Rogue wave Tools.h++ 7.0.7 ($500)
  - NIMS Libraries
- **All this work was completed in one month (thanks to NIMS)**
- **Code runs on both Sun Unix and Windows**
  - Six test programs fixed, and run on both platforms (results matched)

Kodak Software Project

- **Seven libraries out of 10 controlled and compiled**
  - ARIDCPM, JPEG, NITF, OOCASYS, RAS, System, VQ
  - Not interested in three: GIF, TGA, TIFF
  - Approximately 500 library modules (not including makefiles and test programs)
- **54 source code modules modified (1 in 10)**
  - MSVC++ 5.0 compiler enforces language more strictly (27 of 54)
    - » Casts (11)
    - » Explicit construction (4)
    - » Other (12)
  - Platform and compiler differences (12)
    - » Byte ordering (3)
      - Code to handle byte swapping in image data mask subheader was missing
    - » Compile-time template instantiations (5)
    - » Other (4)
  - Bug fixes (10)
    - » Memory leaks/overruns (7)
    - » Other (2)
  - Cosmetic/other (5)